1.3 Project management personnel shall demonstrate a familiarity level knowledge of the application of the civil engineering theories, principles and techniques.

Supporting Knowledge and/or Skills

a. Discuss the basic concepts of architectural design.

The architect designs the style and method of construction of structures and buildings. Architecture has not changed greatly since ancient times.[1] The three, generally accepted principles are:

(1) Building must be constructed to serve a purpose;
(2) Building must be capable of withstanding the elements and normal usage for a reasonable period of time; and,
(3) Building, inside and out, must be visually pleasing.

Methodologies, materials, designs, and uses have all changed over the years, but the above principles never falter.

b. Discuss the basic concepts of structural design and integrity.

The structural designer arranges and proportions structures and their parts so that they will satisfactorily support the loads to which they may feasibly be subjected.[2] It may be said that the structural engineer is involved with the general layout of structures; studies the possible structural forms that can be used; consideration of loading conditions; analysis of stresses, deflections, and so on; design of connections; and the preparation of construction drawings.

Not only must the frame of a structure safely support the loads to which it is subjected, but it must support them in such a manner that deflections and vibrations are not so great as to frighten occupants or to cause unsightly cracks.

The designer needs to keep in mind the factors that can lower cost without sacrifice of strength. These include; the use of standardized sections of members, simple connections, clear details, and materials that do not require an unreasonable amount of maintenance over the lifespan of the project.

c. Discuss the basic concepts of civil transportation design (roads, bridges, etc.)

The transportation engineer is charged with the safe, economical and practical design of roads, signals, bridges, intersections and grade crossings.[3] The transportation engineer's primary responsibility is in the planning of roads for the following reasons:

- Eliminate the existing areas that are overburdened by traffic;
- Replace existing infrastructure as it becomes unsafe or obsolete;

- Accommodate planned expansion; and,
- Improve the quality of service provided by existing roads and bridges.

Transportation planning is the orderly and continuing collection of information about roads, bridges, condition, use, costs and needs, and the analysis of this data for the efficient and economic development of the highway systems. The object of transportation engineering is to establish a highway, bridge and road network capable of accommodating all travel in an orderly, safe, efficient, economical and environmentally friendly manner. The three conditions which the transportation engineer must meet are:

(1) Management of the supply and the unprecedented demand for highways, bridges and roads;
(2) The complex relationships between the many governmental agencies involved in transportation development; and,
(3) The necessity of obtaining the best value for every dollar spent.

In addition to these factors, today's transportation engineer must also deal with environmental problems such as:

- Water drainage, run off, and wet lands preservation;
- Air quality;
- Wildlife migration patterns; and,
- Quality of life issues with local land owners.

The transportation engineer must also deal with other issues, such as traffic light installation, quality control, retrofit decisions, and contractor contract administration.

d. Describe the basic design requirements for sanitary systems.

For protection of the health of building occupants, wastes produced in a building must be removed swiftly in a sanitary manner from the building and then disposed of in a manner acceptable to the community or to state and Federal regulations. Liquid wastes are usually caught in basins and conveyed through pipes out of the building. There are three types of sanitary systems in a building: domestic, storm and industrial.

Domestic wastewater is primarily spent water from the building's water supply, to which added wastes from bathrooms, kitchens, and laundries can add about 0.1% solid matter. There are numerous methods of treatment available, depending upon quantity of sludge, available of a sewer system, and laws regarding disposal. Some treatments require many steps and additional chemicals, while others are quite simple.

Storm water is primarily the water that runs off the roof of the building. The water is channeled through gutters and then to drains. These drains are sometimes hooked to special storm sewers. Special conditions at some buildings, such as large paved areas or steep slopes, may require capture of land drainage in inlets. The treatment of this type of

water is generally less severe, and is not mixed with other wastes due to the large quantities of storm water run off and the high cost of treatment.

Industrial wastes are generally created during some process oriented to use water in the system. Treatment facilities for this type of waste is generally tailored to the specific contaminant. Because of this specialty, the process generally cannot be carried out by the local water treatment facility, and the treatment is a built in component of the building or site.

There are four terms used to describe the phases of treatment, they are briefly described as follows:

(1) Preliminary treatment may be the conditioning of the industrial waste before discharge to remove or neutralize contaminants in the water;
(2) Primary treatment is generally the first and sometimes the only step in the treatment of sewage. It removes larger solids, but does not yield an effluent that is completely treated;
(3) Secondary treatment applies biological methods to the effluent from primary treatment to stabilize the organic component remaining; and,
(4) Tertiary treatment, sometimes referred to water renovation, removes a high percentage of suspended and organic matter.

Upon completion of this process, the water may have a disinfectant added. Sludges removed are sent to digestion tanks where they are further broken down into soil conditioners, fertilizers, etc. Also, thermal pollution may be a concern to a specific site, as the adding of colder or warmer to an environment can be as damaging as adding contaminants.

[1] Merritt, Frederick S. Ambrose, James, *"Building Engineering and Systems Design,"* 2nd ed., Van Nostrand Reinhold, New York, NY, 1990.
[2] McCormac, Jack, *"Structural Steel Design,"* 2nd ed., Harper Collins College Publishers, New York, NY, 1994.
[3] Woods, Kenneth B., *"Highway Engineering Handbook,"* 1st ed., McGraw-Hill, New York, NY, 1960.

1.4 Project management personnel shall demonstrate the ability to read and interpret engineering fabrication, construction, and architectural drawings.

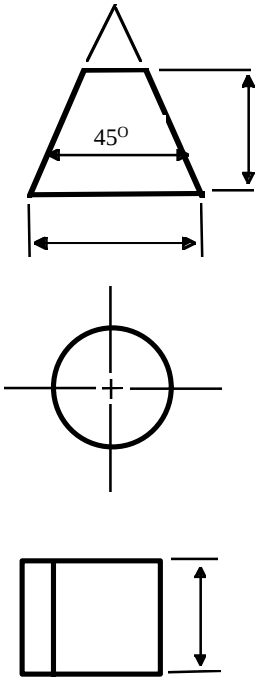
Supporting Knowledge and/or Skills

a. Given the above drawings, read and interpret the following symbology:

This is a demonstration requirement.

Drawings are miniature as well as picture-like representations of a building or object. Because of the relatively small size of drawings, many components cannot be shown on some drawings exactly as they look. Consequently, designers have to use a special kind of graphic language to indicate the many items that cannot actually picture. This language employs symbols to represent materials and components. The following are a single example of basic symbology for the listed topics. To accurately interpret the symbology of a drawing, check the legends and tables and industry references.

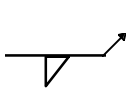
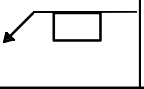
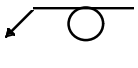
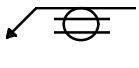
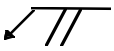
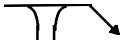
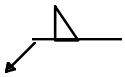
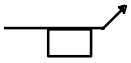
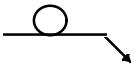
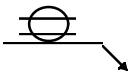
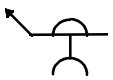
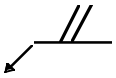
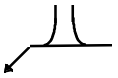
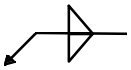
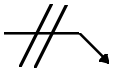
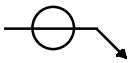
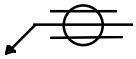
- Basic dimensional and tolerance



Geometric characteristic symbols

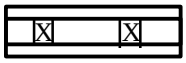
	Type of Tolerance	Characteristic	Symbol
For individual features	Form	Straightness Flatness Circularity (roundness) Cylindricity	
For individual or related features	Profile	Profile of a line Profile of a surface	
For related features	Orientation	Angularity Perpendicularly Parallelism	
	Location	Position Concentricity	
	Runout	Circular runout Total runout	a

- Basic fabrication

Basic Welding Symbols and Their Location Significance								
	Fillet	Plug or Slot	Spot or Projection	Seam	Back or Backing	Surfacing	Scarf for Brazed Joint	Flange Edge
								
						Not used		
		Not used	Not used	Not used	Not used	Not used		Not used
	Not used	Not used			Not used	Not used	Not used	Not used

- Basic construction

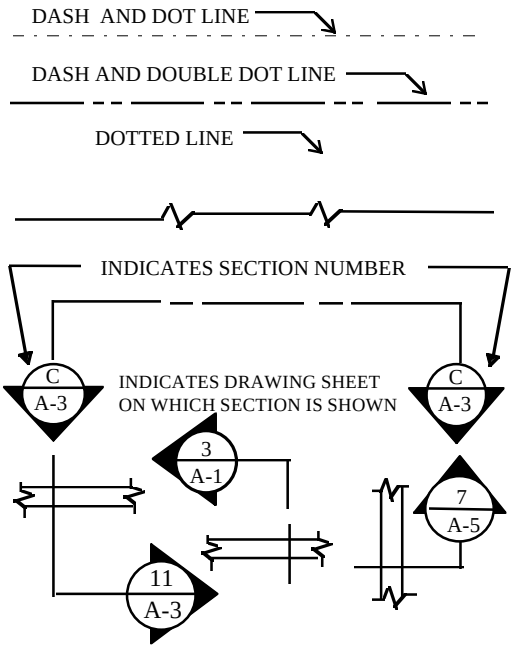
STEEL STUD



WOOD STUD

DASHED LINE DENOTES SPECIAL FINISH FACE - PLAN/SECTION

- Basic architecture



CENTER LINES, FLOOR LINES IN EXTERIOR ELEVATIONS, PROJECTED LINES

PROPERTY LINES, BOUNDARY LINES

CUT LINE OR HIDDEN LINE

TO BREAK OFF PARTS OF DRAWINGS

SECTION LINES AND SECTION REFERENCES

b. Given a drawing and a completed or partially completed product, compare the product against the specifications on the drawing.

This is a demonstration skill.

Use the information represented on the drawings to check dimensions on all elevations and plans, sizes, shape, locations (if applicable), materials, assemblies, equipment, fabrication, finishing, tolerances, and any other information called out on the drawings.